BME2103: MEDICAL BIOTECHNOLOGY IN IMAGING AND MEASUREMENT

Effective Term
Semester B 2022/23

Part I Course Overview

Course Title
Medical Biotechnology in Imaging and Measurement

Subject Code
BME - Biomedical Engineering
Course Number
2103

Academic Unit
Biomedical Engineering (BME)

College/School
College of Engineering (EG)

Course Duration
One Semester

Credit Units
3

Level
B1, B2, B3, B4 - Bachelor's Degree

Medium of Instruction
English

Medium of Assessment
English

Prerequisites
BCH1200/CHEM1200 Discovery in Biology or AP1201/PHY1201 General Physics I#

Precursors
Nil

Equivalent Courses
MBE2103 Medical Biotechnology

Exclusive Courses
Nil

Additional Information
Prerequisites which are not part of the Major Requirement are waived for students admitted with Advanced Standing.

Part II Course Details

Abstract

This course provides a coherent overview of various measurement techniques with relevance to biomedical applications. Students will learn the fundamental concepts of biological and medical measurements, and essential knowledge of the required human physiology. In particular, this course emphasizes on students' understanding of the principle of biomedical imaging and interpretation of image contrast that is related to biology/physiology of a human body. Further, it introduces frontier applications of biomedical imaging to tackle clinical challenges in disease diagnosis and guided-therapy. It also encompasses the characterization and interpretation of data using statistics and Fourier transform that are commonly used in hospitals and other bioengineering/biomedical fields.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	EXPLAIN the working principles of biochemical imaging, cell and molecular measurement methods commonly used for diagnostic purposes and obtaining physiological variables.			x	
2	IDENTIFY basic atomic/molecular structures and cell genetic/physiological/behavioural information based on the results of the measurement strategies introduced in class.			x	
3	DESCRIBE the characteristics of different images, and INTERPRET the basic physiological information reflected by images.			x	
4	APPLY Statistics and Fourier transform for ANALYZING images obtained from biomedical measurements.		x	x	
5	DISCOVER and DESIGN feasible experimental procedures for selected biomedical measurement applications, by integrating various biomedical measurement strategies; and further EXAMINE the defined biomolecules or/and live subjects for their corresponding integrative bio-related characteristics.		x	x	x

A1: Attitude
Develop an attitude of discovery/innovation/creativity, as demonstrated by students possessing a strong sense of curiosity, asking questions actively, challenging assumptions or engaging in inquiry together with teachers.

A2: Ability
Develop the ability/skill needed to discover/innovate/create, as demonstrated by students possessing critical thinking skills to assess ideas, acquiring research skills, synthesizing knowledge across disciplines or applying academic knowledge to real-life problems.

A3: Accomplishments
Demonstrate accomplishment of discovery/innovation/creativity through producing /constructing creative works/new artefacts, effective solutions to real-life problems or new processes.

Teaching and Learning Activities (TLAs)

	TLAs	Brief Description	CILO No.	Hours/week (if applicable)
1	Lecture	Introduce fundamental concepts and skills related to biomedical measurement, provide case studies, and introduce project.	1, 2, 3, 4, 5	3 hrs/week
2	Tutorial	Provide opportunities for students to practice the lecture materials.	1, 2, 3, 4, 5	1 hr/week
3	Laboratory Work	Provide opportunities for students to establish their hands-on experiments via the laboratories.	1, 2, 4, 5	3 hrs/week for 2 weeks

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks (e.g. Parameter for GenAI use)
1	Mid-Term Exam	1, 2, 3, 4, 5	30	2 hrs
2	Laboratory Reports	1, 2, 4	20	3-4 individual reports to be submitted

Continuous Assessment (%)

50

Examination (%)

50

Examination Duration (Hours)

2

Additional Information for ATs

For a student to pass the course, at least 30% of the maximum mark for both coursework and examination should be obtained.

Assessment Rubrics (AR)

Assessment Task

1. Mid-Term Exam

Criterion

Capability of applying the concepts introduced in lectures for analysis of results from biomedical measurements.

Excellent (A+, A, A-)

High

Good (B+, B, B-)

Significant

Fair (C+, C, C-)

Moderate

Marginal (D)
Basic

Failure (F)
Not even reaching marginal levels

Assessment Task
2. Laboratory Reports

Criterion
Interpretation of results obtained from biomedical measurements covered in the laboratory session.

Excellent (A+, A, A-)
High

Good (B+, B, B-)
Significant

Fair (C+, C, C-)
Moderate

Marginal (D)
Basic

Failure (F)
Not even reaching marginal levels

Assessment Task
3. Examination

Criterion
Capability of applying the concepts introduced in lectures for analysis of results from biomedical measurements.

Excellent (A+, A, A-)
High

Good (B+, B, B-)
Significant

Fair (C+, C, C-)
Moderate

Marginal (D)
Basic

Failure (F)
Not even reaching marginal levels

Part III Other Information

Keyword Syllabus

- Clinical measurements: microscopy, radiography, ultrasonography, computed tomography, magnetic resonance imaging, positron emission tomography, photoacoustic tomography, blood pressure, blood flow, oxygen saturation, glucose
- Basic Biostatistics: probability, Bayes' theorem, statistical estimation, statistical inference, confidence interval, hypothesis testing, Student's t-test, analysis of variance, correlation, regression

Reading List

Compulsory Readings

	Title
1	Nadine Barrie Smith, Andrew Webb (2010). Introduction to Medical Imaging. Cambridge University Press.
2	John G. Webster (2010). Medical instrumentation: application and design (4th edition). Hoboken, New Jersey, United States: John Wiley & Sons Ltd.

Additional Readings

	Title
1	David A Lisle (2012). Imaging for Students. Taylor & Francis Ltd.
2	Herman Cember, Thomas E. Johnson (2008). Introduction to Health Physics. McGraw-Hill Education.
3	Jerrold T. Bushberg, J. Anthony Seibert, Edwin M. Leidholdt, John M. Boone (2011). The Essential Physics of Medical Imaging. Lippincott Williams & Wilkins.
4	Lihong V. Wang, Hsin-I Wu (2009). Biomedical Optics: Principles and Imaging. John Wiley & Sons, Inc.
5	Judit Pongracz, Mary Keen (2009). Medical biotechnology (1st edition). Edinburgh, New York, United States: Churchill Livingstone/Elsevier.